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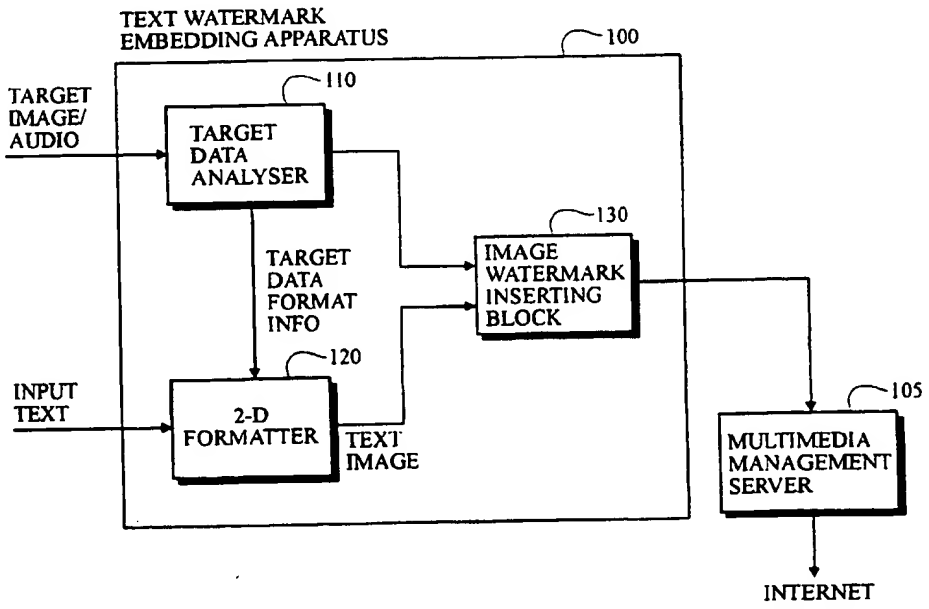

(57) Abstract: A text is inserted as watermark into digital data by using wavelet transform and discrete cosine transform. The method of inserting a text into digital data comprises the steps of: converting said digital data to have a 2-dimensional image format; converting the text to have the 2-dimensional image format; and inserting the converted text into the converted digital data by using DCT and DWT. The text is extracted from the text watermarked digital data by recovering the converted text of the 2-dimensional format using the text watermarked digital data and the original digital data; and extracting the text form the recovered text of the 2-dimensional format.

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METHOD AND APPARATUS FOR EMBEDDING TEXT WATERMARK

TECHNICAL FIELD

The present invention relates to a method and apparatus for embedding a text watermark into target data such as color images, black and white images and audio data. More particularly, it relates to a method for embedding a text watermark in target data such that the inserted text is not damaged by digital signal processing such as compression, filtering, re-sampling, or cropping.

BACKGROUND ART

With the development of computer networks and digital multimedia, protection of intellectual property has become a prime concern for creators and publishers of digitized copies of copyrightable works, such as musical recordings, movies, and video games. One method of protecting copyrights in the digital domain is to use "digital watermarks". Basically, watermarking is a technique for embedding a characteristic mark into each individual copy of a digitized work protected by copyright. Such mark may identify the title, the copyright holder, and even the licensed owner of a particular copy. The watermarking process can embed the identifying information in the multimedia data without significantly increasing the size of the resultant watermark-inserted original data.

To date, various watermarking techniques have been developed which vary depending on the type of data they handle and the type of transformation technique they employ.

A copending PCT application International Application Number PCT/US99/20649 filed on September 10, 1999, entitled

"Watermarking of digital images using wavelet and discrete cosine transforms," assigned to the same assignee of the present application, which is incorporated herein by reference, discloses a method for embedding image watermark into image data using wavelet and discrete cosine transforms (WT and DCT).

A copending USA application serial number of 09/537,308 filed on March, 29, 2000, entitled "Digital Watermarking method and apparatus," assigned to the same assignee of the present application, which is incorporated herein by reference, discloses a method for embedding image watermark into digital audio data using wavelet and discrete cosine transform.

Information related to copyrights includes text such as the title, name of the author and other licensing information. However, conventional watermarking technologies did not offer an efficient method for embedding texts as watermark. Moreover, if text can be inserted into other kinds of data without being noticed, it can be utilized to transfer important messages together with the multimedia data without being tampered. This, there is a compelling need for an efficient watermarking technique for inserting text as watermark into digital data.

DISCLOSURE OF THE INVENTION

It is, therefore, a primary object of the present invention to provide a method for inserting a text watermark into digital data such as audio/image data.

It is another object of the present invention to provide a method for extracting a text from text watermarked digital data.

In one aspect of the present invention, there is provided a method of inserting/embedding a text into digital

data comprising the steps of:

converting said digital data to have a 2-dimensional image format;

converting the text to have the same 2-dimensional image format; and

inserting the converted text into the converted digital data.

In another aspect of the present invention, there is provided a method of inserting a text into original digital data and transferring the text inserted digital data, comprising the steps of:

converting the digital data to one in a predetermined 2-dimensional image format;

converting the text to one in said predetermined 2-dimensional image format;

inserting the converted text into the converted digital data in the 2-dimensional format, to provide text watermarked digital data;

transmitting said text watermarked digital data;

receiving the text watermarked digital data;

recovering the converted text of the 2-dimensional format by using the text watermarked digital data and the original digital data; and

extracting the text from the recovered text.

In yet another aspect of the present invention, there is provided a system for extracting a text from text watermarked digital data and transmitting the extracted text, comprising:

means for storing a plurality of digital data;

means for transmitting, to a first user, digital data selected in response to a request of the first user;

means for receiving the text watermarked digital data which is generated by converting the digital data transmitted to the first user in a predetermined 2-dimensional format, converting a text selected by the

first user in said predetermined 2-dimensional format, and inserting the formatted text into the formatted digital data;

means for recovering said converted text of the 2-dimensional format by using the text watermarked digital data and the selected digital data;

means for extracting the text from the recovered text;

means for encoding the extracted text; and

means for transmitting the encoded text to a second user.

BRIEF DESCRIPTIONS OF THE DRAWINGS

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 shows schematic block diagram of the text watermark embedding apparatus in accordance with the present invention;

Fig. 2 is a detailed diagram of the 2-D formatter 120 shown in Fig. 1;

Fig. 3 is a detailed block diagram of the value set providing block 210 shown in Fig. 2;

Fig. 4 shows three exemplary scheme for making up 2-D text image by using the value set;

Fig. 5 shows a detailed block diagram of the target data analyzer 110 shown in Fig. 1;

Fig. 6 is a detailed block diagram of the image watermark inserting block 130 shown in Fig. 1;

Fig. 7 shows a process for embedding a text watermark;

Fig. 8 shows an apparatus for extracting text from watermarked audio/image signal;

Fig. 9 shows a schematic block diagram of the text

extractor shown in Fig. 8;

Fig. 10 shows an embodiment of a system for transmitting/receiving data on the Internet which utilizes the text watermark embedding and text extracting method of the present invention; and

Fig. 11 shows another embodiment of a system for transmitting/receiving data on the Internet which utilizes the text watermark embedding and text extracting method of the present invention.

MODE OF CARRYING OUT THE INVENTION

Fig. 1 shows a block diagram of the text watermark embedding apparatus in accordance with the present invention. The text watermark embedding apparatus of the present invention receives a target data which is image or audio data and a text which will be embedded into the target data. By combining these two different kinds of data, the apparatus 100 provides image or audio data where a text watermark is inserted.

To do this, a 2-dimensional ("2-D") formatter 120 converts text to be inputted into 2-dimensional formatted data (hereinafter "text image"). In this specification, text refers to one or more characters or symbols, at least part of image or audio, or a set including at least one of them. For example, the string "Why don't you meet me at 3 P.M.?" is a text since it is a set including a plurality of characters. The text image is inserted into the target data by using the image watermarking method which can insert an image watermark into a target data.

The text watermark embedding apparatus 100 shown in Fig. 1 includes a target data analyzer 110, a 2-D formatter 120, and an image watermark inserting block 130. The target data analyzer 110 studies the target image/audio data which was

received in various formats and discriminates its format. Then, it separates overhead information such as headers from the target image/audio data and provides data which represents pure image or audio. Then, it converts the data into a 2-dimensional image format and provides the formatted data to the watermark inserting block 130. The target data analyzer 110 also extract information on the target data format ("target data format information") such as the size of the image, the color mode, bit arrangement structure of each pixel data, and provides the target data format information to the 2-D formatter 120. Using this format information, the 2-D formatter 120 arranges the text image to have the same format as that of the data which is inputted to the image watermark inserting block 130 from the target data analyzer 110.

The image watermark inserting block 130 inserts the text image from the 2-D formatter 120 into the target data in the 2-D image format so as to provide text watermarked data. The text watermarked data may be distributed via a multimedia management server 105 to users around the world.

Fig. 2 is a detailed diagram of the 2-D formatter 120 shown in Fig. 1. The 2-D formatter 120 includes a value set providing block 210 that receives a text string such as "Why don't you meet me at 3 P.M.?" and converts the text into a set of numbers, which will be referred to as a "value set", each number having one of assigned values. The 2-D formatter 120 further includes an image constructing block 220 which receives the value set and generates from the value set a text image which is a text converted into 2-D image format. The image constructing block 220 uses the target data format information to provides a text image having the same 2-D format with that of the target image or audio provided from the target data analyzing block 110.

Fig. 3 is a detailed block diagram of the value set providing block 210 shown in Fig. 2. The value set

providing block 210 includes a bit generator 310 for converting the text into a binary bit stream and a mapping block 320 for mapping each binary bit to one of two assigned values. For example, binary 0 is mapped to a value 0 and binary 1 is mapped to a value 255. In one embodiment of the present invention, the bit generator 310 converts the text "Why don't you meet me at 3 P.M.?" into the binary bit stream "100011001..." and the mapping block 320 converts the binary bit stream "100011001..." into "255 0 0 0 255 255 0 0 255 ...." Though 0 and 255 are chosen for illustration, the assigned values can be any values. The assigned values may be fed to the mapping block 320 from outside as T shown in Fig. 3. It is preferable to choose two values which are distinct from each other. For example, in a system where values are represented in unsigned binary bits, 0 and 255 are represented as "00000000" and "11111111." Since the Euclidean distance between the numbers is the maximum, 0 and 255 are preferred as the set of assigned values. A pair of values such as "00001111" and "00011111" are not preferred since only one bit of error in the first value would have the value seen as the other.

Fig. 4 shows three exemplary schemes for making up 2-D text image by using the value set. The strip in Fig. 4a depicts a value set. In Fig. 4b, the value set is formatted into one or more lines of an image. In the last row, a portion which is not filled with the assigned values in the value set is made blank. Repeating these two lines including the blank region results in a text image as shown in Fig. 4b.

In Fig. 4c, the set of assigned values are repeatedly placed in predetermined locations, for example, the start of first, fourth and seventh lines in Fig. 4c. Remaining portions are filled with blanks.

In Fig. 4d, the set of assigned values are repeated without inserting blank between two consecutive sets.

Instead, a mark which is distinct from data in the sets is inserted between two sets. For example, "1111111111111111' can be used as the mark since this bit pattern is very unlikely to be part of the value set.

The above method can be implemented by storing the sets of assigned values in certain location in a frame memory. In that case, Fig. 4 also represents contents of the frame memory. Like the error correction coding scheme, repetition of the value set also helps to recover the exact original text without being affected by transmission error.

Fig. 5 shows a detailed block diagram of the target data analyzer 110 shown in Fig. 1. A data format analyzer 510 analyzes audio or image signals in various formats and extracts data which represents only audio or image without including additional information such as a header. Specifically, when image signals are inputted to the data format analyzer 510, it detects the size of the image and provides it to the 2-D formatter 120 as the target data format information. The analyzer 510 extracts raw 2-D image data representing pixel values. The analyzer 510 provides the image data in 2-D format to the YIQ converter 520 in case of the color image and directly to the image watermark inserting block 130 in case of the black and white image. The YIQ converter 520 converts the color image in RGB mode into the color image in YIQ mode and provides the only Y component to the image watermark inserting block 130. Thus, a watermark is inserted into the Y component of an image.

When audio signals are inputted to the data format analyzer 510, the data format analyzer 510 extracts raw audio stream and provides it in 2-D image format to the image watermark inserting block 130. In doing this, the 2-D image format, for example the size of the image, may be assigned to a certain value or may be determined by a user.

Fig. 6 is a detailed block diagram of the image watermark inserting block 130 shown in Fig. 1. The Y

component of the color image, the black-and-white image or audio data in 2-D format, which is provided from the target data analyzer 110, is transformed by WT in a wavelet transform block 610 shown in Fig. 6. The text image from the 2-D formatter 120 is transformed by DCT in the DCT block 620. The transformed data is combined in the mixer 630 and then transformed by inverse wavelet transform("IWT") in the IWT block. The inverse wavelet transformed data is audio data, B/W image data or Y component of the color image where a text watermark is inserted. The watermarked data may be distributed via the Internet by an Internet management server. Although not shown in the figure, in case of a color image, I and Q components may bee recombined into the watermarked Y component and YIQ image data may be converted back to RGB format before being distributed.

Although not shown in the figures, an error correcting encoder may be used to make it possible to recover the original text without being affected by transmission error after the watermarked data is transmitted via the Internet. The error correcting encoder can be placed before the data is transmitted over the Internet. The error correcting encoder 330 may utilize, without limitation, parity bits, convolutional coding or any other known error correcting coding method.

Fig. 7 shows a process for embedding a text watermark. In step S700, audio or image data in 2-D image format ("D") is provided.

In step S710, D is transformed by $WT(T_{WT})$ to provide transformed data "X". In the present invention, image or audio signal in 2-D format is transformed by DWT before being mixed with the transformed text watermark. To reduce computational burden, a fast WT using filter banks is used.

In step S730, a text image W is provided and it is transformed by discrete cosine transform("DCT", T_{DCT}) in step S740 to provide transformed text image y. In step S720, the

transformed text image y is weighted by α and then added to the transformed data X. With large value of α, it is easy to recover the watermark, but embedding of a watermark may cause degradation in the quality of audio or image. With a small value of α, even slightest noise added to a watermarked data may make it difficult to recover the text watermark. The value of weight α may be decided by a user. Alternatively, an optimum weight value may be determined after testing with typical image or audio data. The combined data X' is transformed by IWT in step S750, to provide watermarked audio or image data D_{WM}.

As described above, in the present invention, a text is first converted into a text image in a 2-D image format and then a method for inserting a 2-D watermark (watermark image) into the 2-D data (original image) is utilized which will be explained below.

In an alternative embodiment of the present invention, transformed text image $T_{DCT}(W)$ may be transformed by WT before it is combined with $T_{WT}(D)$. In that case, image/audio data and $T_{DCT}(W)$ may be transformed in different signal levels.

Fig. 8 shows an apparatus for extracting the original text from a text watermarked audio/image data. The text watermarked data and the original image/audio data are transformed by WT in blocks 810 and 820 respectively and the difference between them is calculated. The difference is transformed by IDCT to provide a recovered text image. From the recovered text image, the text extractor 850 determines what the original text was.

Fig. 9 shows a block diagram of the text extractor shown in Fig. 8. Since data in the recovered text image is obtained by IDCT, it has floating point values. In the integer conversion block 910, these floating point values are converted to one of the assigned values by truncation. In one embodiment, in case that the assigned values are 0

and 255, values not greater than 128 are converted to 0 and values greater that 128 are converted to 255. Various other methods may be used to select one assigned value used in the watermarking system for each of the floating point numbers.

After being converted to assigned values, the data is subject to processing steps which are the inverse of the process for making a text image out of a text, which is explained with reference to Figs. 2 and 3.

As mentioned above, a text image includes repeated sets of assigned values and, marks or blanks between sets. From the value set extracting block 920, a number of value sets are provided, excluding blanks and marks.

Data (0 or 255) in each value set is converted to a set of binary bits in the inverse mapping block 940.

In the candidate text generation block 950, the inverse of the process performed in the bit generator 310, that is, conversion of each set of bit stream into a text is done. A plurality of texts obtained from the sets of binary bit stream are called candidate texts.

Although not shown in the figure, the text extractor may include an error correction decoder which corresponds to an error correction encoder included in the watermark embedding stage, to correct errors such as transmission errors.

Since identical value sets are repeated to form the text image in the watermark embedding apparatus, value sets extracted by the value set extracting block 920 should be identical provided that there was no transmission errors and thus candidate texts should be all identical. Even if all of the candidate texts are not identical because of transmission error, one can recover the original text by, for example, selecting the most frequent text.

Methods for producing a text image from a text is not limited to those described in this specification. For example, in one embodiment of the present invention, for

each symbol, 8 by 8 image matrix is determined so that the matrix represents the shape of the symbol. To form a text image, a number of 8 by 8 matrices corresponding to the text are repeated to fill a 2-D image. In the text image which is created by this method, the shapes of the symbols in the text are repeated. After the text image is inserted into image or audio data and then transmitted, a symbol which best matches each 8 by 8 matrix in a recovered text image should be decided in order to recover the original text. To do this, various matching technique can be used, including but not limited to character recognition method that uses a neural network.

The text watermark inserting apparatus 100 or the text recovering apparatus is depicted as apparatus including many functional blocks. Preferably, they can be implemented as computer programs which are executed in a general-purpose computer such as a personal computer or workstation. Each functional block will correspond to each sub-program or subroutine. Especially, as the computational capability of personal computers is increased and the memory capacity gets much larger, it is possible to process image data in a personal computer. After the watermarking process is done in a personal computer, the watermarked data may be distributed over the Internet coupled by modem or other communication lines without going through the server shown in Fig. 1. Similarly, recovering of text from watermarked data can be done in the personal computer.

In a program for watermarking, the text used as a watermark may be inputted through keyboard. The program may be designed to receive two assigned values, the method for repeating the value sets, and the weight value used by combining X and y shown in Fig. 7 from users of the program.

A text watermarking method of the present invention may be applied to communication of important transaction data in the electric commerce. For example, important data such as

transaction order, electronic money, debit note can be transmitted securely without being disclosed to a third party by using the method of the present invention.

Users can transmit and receive data directly with each other by using the text watermark embedding and extracting method of the present invention. However, by establishing an independent watermarking institution as shown in Fig. 10 and 11, more secure data transmission can be achieved. In the system shown in Fig. 10, the user can only insert a text watermark into an original data while a server in the institution can extract the watermark from the watermarked data. On the contrary, in the system shown in Fig. 11, the user can only extract text watermark from watermarked data while a server in the institution inserts text watermark.

Fig. 10 shows an embodiment of a system for transmitting/receiving data on the Internet which utilizes the text watermark embedding and text extracting method of the present invention. In the system shown in Fig. 10, the watermarking institution includes a database of user information, a database of image/audio data, a text extracting program and an encoding program. If a user A selects and requests one among the image/audio data stored in the watermarking institution via network, a server in the watermarking institution transmits the image/audio data to the user. The user A inserts a text watermark to this data and transmits the watermarked data back to the watermarking institution. The watermarking institution extracts the watermark from the watermarked data, encodes the original image/audio data and the watermark using its own encoding scheme, and sends the encoded data to a user B. The user B can obtain the image/audio data and the text by decoding the encoded data. The user A and the watermarking institution have the watermarking/extracting method in common, while the watermarking institution and the user B have the encoding/decoding method in common. But both of encoding

and decoding methods or inserting and extracting method are not disclosed to the general public. As a result the overall system may be very secure. Thus, by using this scheme, it is possible to transfer important data without being tampered even via an insecure communication network such as the Internet.

Fig. 11 shows another embodiment of a system for transmitting/receiving data on the Internet which utilizes the text watermark embedding and text extracting method of the present invention. In the system shown in Fig. 11, the watermarking institution includes a database of user information, a database of image/audio data, a text watermarking program and a decoding program. First, a user sends to the watermarking institution data encoded by an encoding method predetermined between the user A and the watermarking institution. The user also selects image/audio data in the database of the institution. Then, the server of the watermarking institution decodes the encoded text, inserts the text into the selected image/audio signal as a watermark and transfers the watermarked data to a user B. The user B extracts the text by using a program which does the exact inverse of the watermarking procedure in the institution.

By including a third party institution in the system, either insertion or extraction is only done by the institution and thus both of them do not have to be disclosed to the general public. Further, billing for the use of the watermarking method becomes easier.

Compared to the conventional watermarking method where random numbers are used as watermarks, the present invention makes it easier to embed copyright related information into image/audio data. Also, by repeating the value set and using the error correction method, it is possible to recover the original text even after watermarked data is transmitted through a noisy channel. By using DCT and WT, the text

watermark data is not much damaged after undergoing digital processing such as compression, filtering and re-sampling.

While the present invention has been described and illustrated with respect to the particular embodiment, it will be apparent to those skilled in the art that variations and modifications are possible without deviating from the broad principles and teachings of the present invention which should be limited solely by the spirit and scope of the claims appended hereto.

WHAT IS CLAIMED IS:

1. A method of inserting/embedding a text into digital data comprising the steps of:

(a) converting said digital data to have a 2-dimensional image format;

(b) converting the text to have the same 2-dimensional image format; and

(c) inserting the converted text into the converted digital data.

2. The method according to claim 1 wherein said text includes one or more of a character, a symbol, and at least part of image or audio which can be generated, represented, received or transmitted in a computer or a combination thereof.

3. The method according to claim 1, wherein said text is made of a series of symbols such as alphanumeric characters.

4. The method according to claim 3, wherein said converting step comprises:

converting said symbols to a corresponding set of assigned values; and

repeating said set of assigned values in series to form the text in the 2-dimensional format.

5. The method according to claim 4, wherein said repeating step includes placing said set of assigned values in at least one predetermined position in said image format.

6. The method according to claim 4, wherein said repeating step includes inserting a mark between two

consecutive sets of assigned values, said mark being distinct from the assigned values.

7. The method according to claim 4, wherein said repeating step includes:

converting the set of assigned values into one or more lines in the 2-dimensional image format; and

repeating said one or more lines to form the text in the image format.

8. The method according to claim 4, wherein said step of converting said symbols into a corresponding set of assigned values includes:

converting said symbols into a set of binary bit stream; and

converting said binary bit stream into said assigned values.

9. The method according to claim 8, wherein said assigned values are two pixel values ranging from 0 to 255.

10. The method according to claim 9, wherein said two pixel values being much apart in distance from each other.

11. The method according to claim 1, wherein said digital data represent image or audio signal.

12. The method according to claim 11, wherein said step of converting said digital data into a predetermined 2-dimensional image format includes:

extracting format information from the digital data; and

if the digital data represents color image signal, converting the color image from RGB format into YIQ format, extracting the Y component, and providing the

Y component in the predetermined image format.

13. The method according to claim 11, wherein said step of inserting the text in 2-dimensional format into the digital data in said 2-dimensional format includes:

converting the digital data in the 2-dimensional format by using discrete wavelet transform;

converting the text in the 2-D format by using discrete cosine transform; and

combining discrete cosine transformed text in the 2-dimensionals format with wavelet transformed digital data, to provide text watermarked digital data.

14. The method according to claim 13, wherein said combining step includes:

adding the discrete cosine transformed text in the 2-dimensional format with the wavelet transformed digital data; and

inverse wavelet transforming the added data.

15. The method according to claim 14, wherein said combining step further includes:

weighting the discrete cosine transformed text in the 2-dimensional format before added to the wavelet transformed digital data.

16. A method of extracting a text from text watermarked digital data which is obtained by:

converting original digital data to one in a predetermined 2-dimensional image format;

converting the text to one in said predetermined 2-dimensional image format; and

inserting the converted text into the digital data, to provide text watermarked digital data,

said method comprising the steps of:

providing a recovered text in the 2-dimensional format by using the text watermarked digital data and the original digital data; and

extracting the text from the recovered text in the 2-D format.

17. The method according to claim 16, wherein said step of extracting recovered text in the 2-dimensional format includes:

mapping each data in the recovered text in the 2-dimensional format into one of assigned values;

obtaining sets of assigned values from the mapped values;

converting each set of assigned values into binary bit stream;

deciding a candidate text for each binary bit stream;

selecting one among the candidate texts and providing the selected one as the text.

18. The method according to claim 16, wherein said step of providing the recovered text in the 2-D format includes:

discrete wavelet transforming the text watermarked digital data and the original digital data and determining the difference between the two discrete wavelet transformed data; and

inverse discrete cosine transforming the difference, to provide the recovered text in the 2-dimensional format.

19. A method of inserting a text into original digital data and transferring the text inserted digital data, comprising the steps of:

converting the digital data to one in a predetermined 2-dimensional image format;

converting the text to one in said predetermined 2-

dimensional image format;

inserting the converted text into the converted digital data in the 2-dimensional format, to provide text watermarked digital data;

transmitting said text watermarked digital data;

receiving the text watermarked digital data;

recovering the converted text of the 2-dimensional format by using the text watermarked digital data and the original digital data; and

extracting the text from the recovered text.

20. A system for inserting a text into digital data and transferring the text inserted digital data, comprising:

(a) means for inserting a text watermark into digital data, to provide text inserted digital data;

(b) means for transmitting and receiving the text watermarked digital data; and

(c) means for extracting the text from the received digital data,

wherein said means for inserting includes:

(a1) means for converting the digital data in a predetermined 2-dimensional image format;

(a2) means for converting the text in the predetermined 2-dimensional image format; and

(a3) means for inserting the converted text into the converted digital data, thereby providing the text inserted digital data,

and said means for extraction includes:

(c1) means for recovering the converted text of the 2-dimensional format by using the text inserted digital data and the digital data; and

(c2) extracting the text from the recovered text.

21. Computer readable storage medium where a program of computer-executables instructions is embodied to perform

steps in a method for inserting a text watermark to digital data, said method comprising the steps of:

converting said digital data in a predetermined 2-dimensional image format;

converting the text in said predetermined 2-dimensional image format; and

inserting the converted text into the converted digital data.

22. Computer readable storage medium where a program of computer-executable instructions is embodied to perform steps in a method of extracting a text from text watermarked digital data which is obtained by:

converting digital data in a predetermined 2-dimensional image format;

converting a text in said predetermined 2-dimensioanl image format; and

inserting the converted text into the converted digital data, to provide the text watermarked digital data,

said extracting method comprising the steps of:

recovering the converted text of the 2-dimensional format by using the text watermarked digital data and the digital data; and

extracting the text from the recovered text.

23. A system for extracting a text from text watermarked digital data and transmitting the extracted text, comprising:

means for storing a plurality of digital data;

means for transmitting, to a first user, digital data selected in response to a request of the first user;

means for receiving the text watermarked digital data which is generated by converting the digital data transmitted to the first user in a predetermined 2-

dimensional format, converting a text selected by the first user in said predetermined 2-dimensional format, and inserting the formatted text into the formatted digital data;

means for recovering said converted text of the 2-dimensional format by using the text watermarked digital data and the selected digital data;

means for extracting the text from the recovered text;

means for encoding the extracted text; and

means for transmitting the encoded text to a second user.

24. A system for inserting a text watermark into digital data and transmitting the text watermarked digital data, comprising:

(a) means for receiving an encoded text which has been encoded by a first user;

(b) means for decoding the encoded text;

(c) a database including a plurality of digital data ;

(d) means for inserting the decoded text into digital data selected in response to a request of the first user, to provide text watermarked digital data; and

(e) transmitting the text watermarked digital data to a second user,

wherein said means for inserting comprises:

(d1) means for converting the selected digital data to a predetermined 2-dimensional image ;

(d2) means for converting the decoded text to a predetermined 2-dimensioanl image; and

(d3) means for inserting the converted text into the converted digital data.

Fig. 1

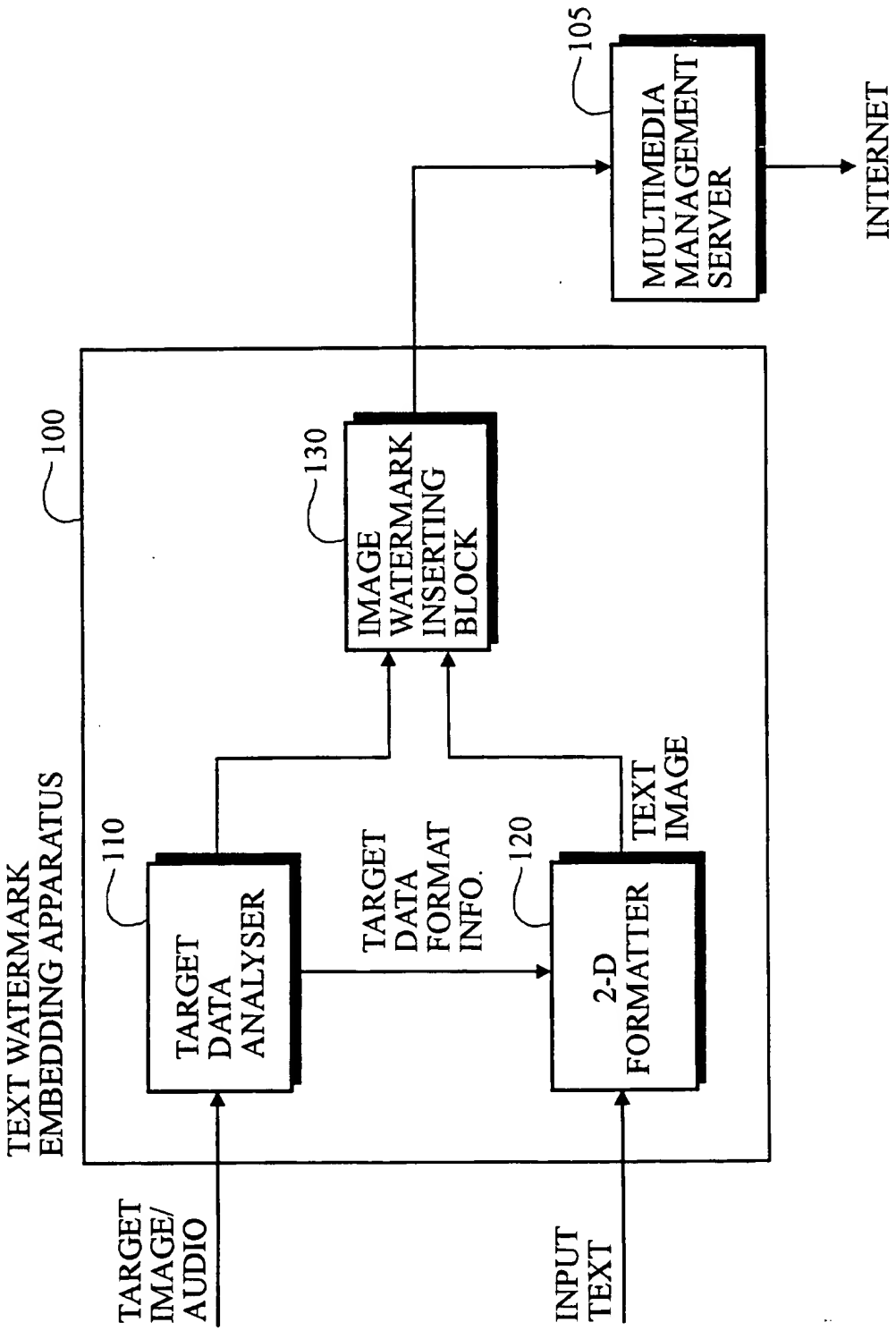

TEXT WATERMARK EMBEDDING APPARATUS
100
TARGET IMAGE/ AUDIO
INPUT TEXT
110
TARGET DATA ANALYSER
TARGET DATA FORMAT INFO.
120
2-D FORMATTER
TEXT IMAGE
130
IMAGE WATERMARK INSERTING BLOCK
105
MULTIMEDIA MANAGEMENT SERVER
INTERNET

Fig. 2

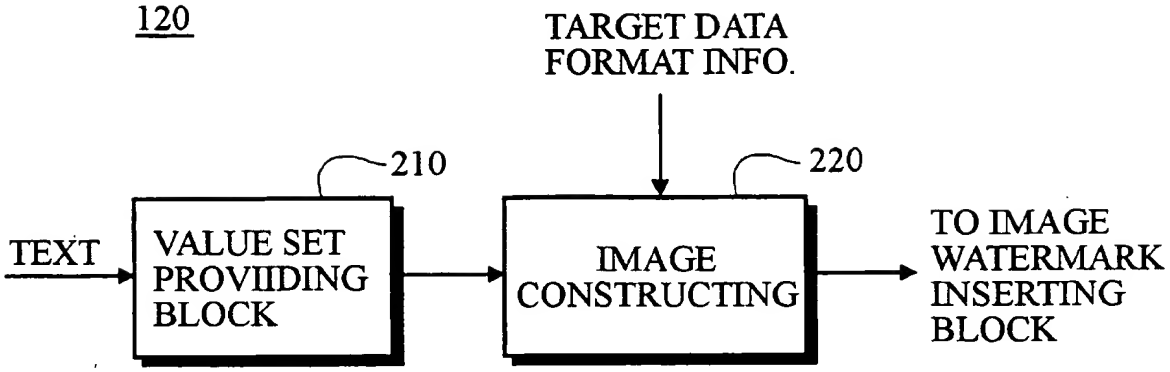

120
TARGET DATA FORMAT INFO.
210
220
TEXT
VALUE SET PROVIIDING BLOCK
IMAGE CONSTRUCTING
TO IMAGE WATERMARK INSERTING BLOCK

Fig. 3

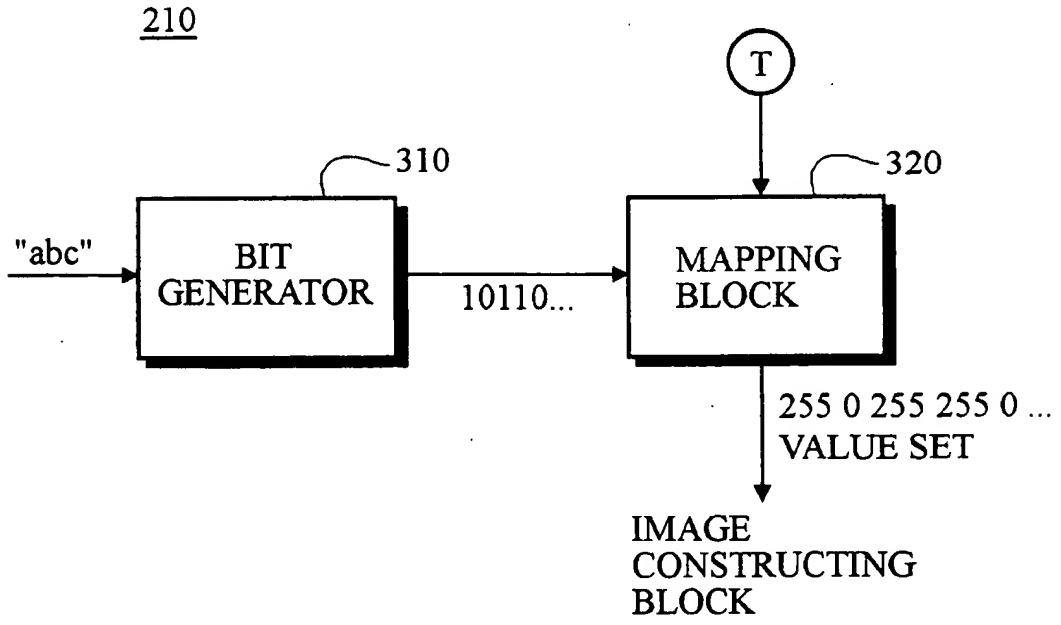

210
T
310
320
"abc"
BIT GENERATOR
10110...
MAPPING BLOCK
255 0 255 255 0 ...
VALUE SET
IMAGE CONSTRUCTING BLOCK

Fig. 4

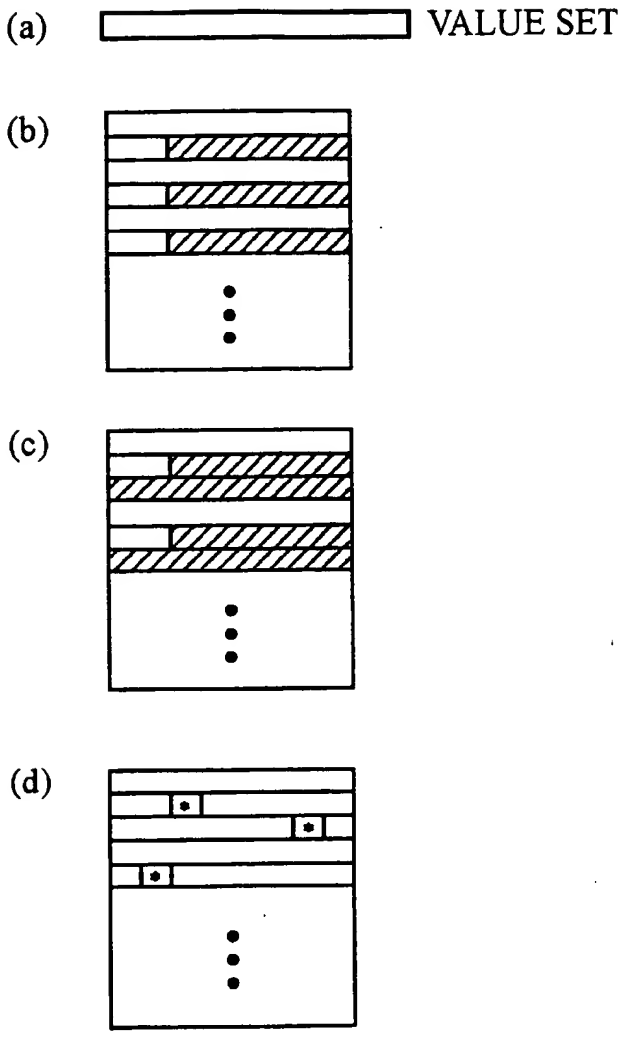


Fig. 5

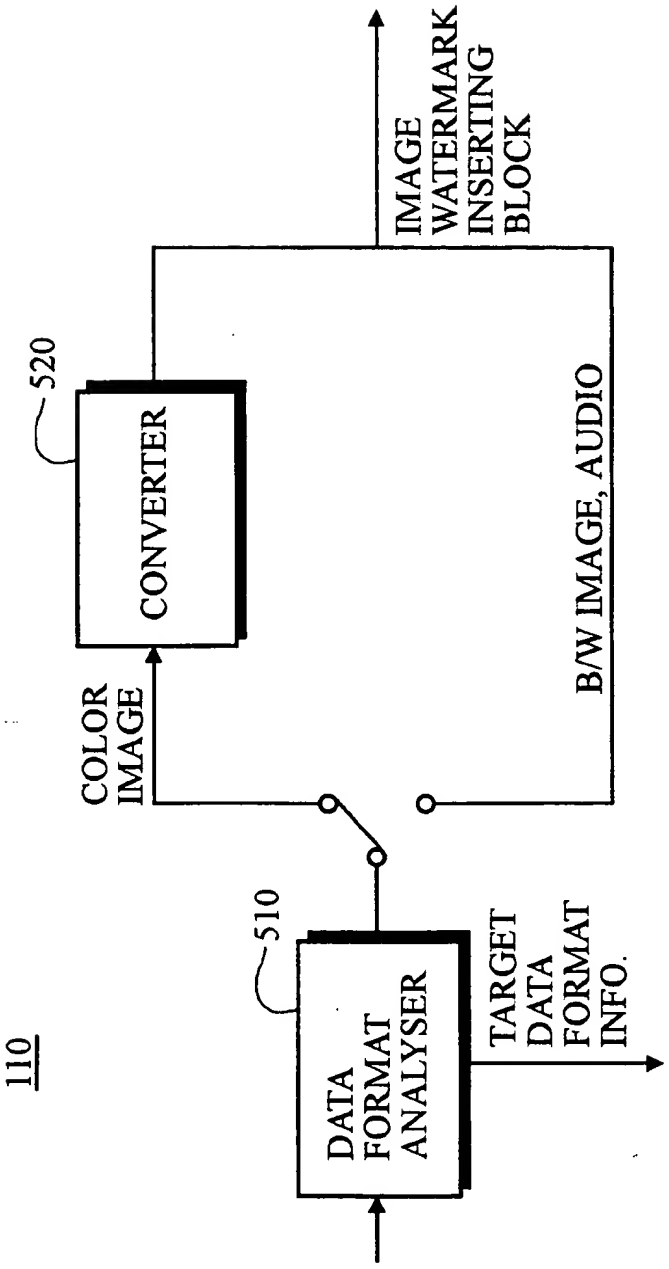

110
DATA FORMAT ANALYSER
510
TARGET DATA FORMAT INFO.
COLOR IMAGE
CONVERTER
520
B/W IMAGE, AUDIO
IMAGE WATERMARK INSERTING BLOCK

Fig. 6

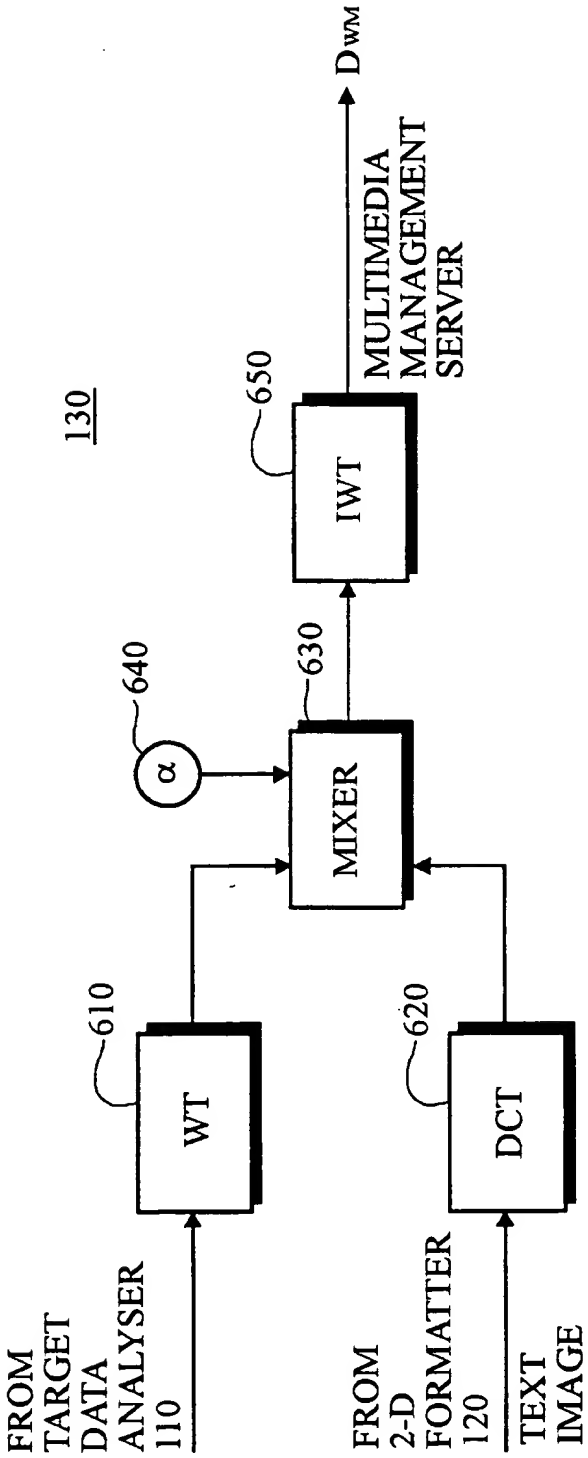

130
FROM TARGET DATA ANALYSER 110
FROM 2-D FORMATTER 120
TEXT IMAGE
WT
DCT
610
620
MIXER
630
α
640
IWT
650
D_{WM}
MULTIMEDIA MANAGEMENT SERVER

Fig. 7

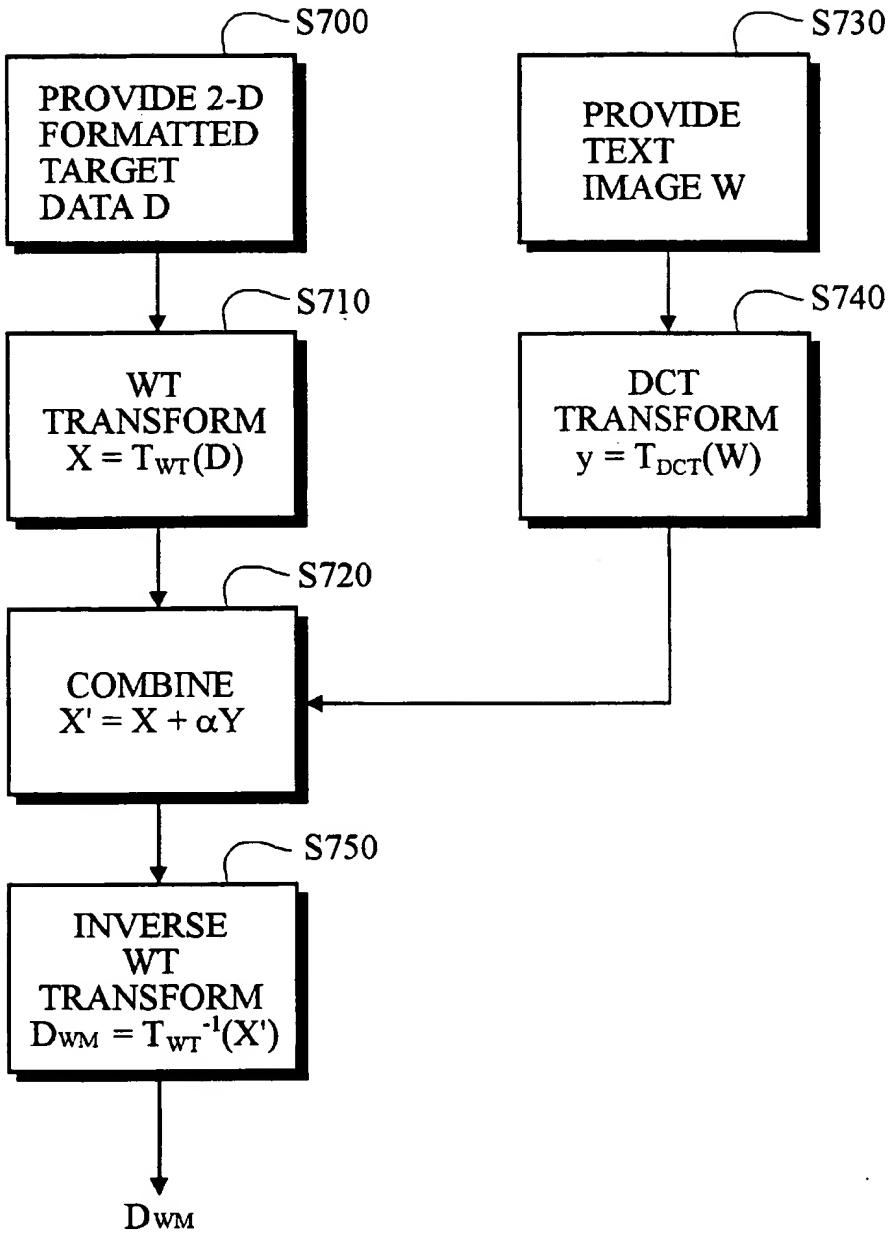

S700
PROVIDE 2-D FORMATTED TARGET DATA D
S730
PROVIDE TEXT IMAGE W
S710
WT TRANSFORM $X = T_{WT}(D)$
S740
DCT TRANSFORM $y = T_{DCT}(W)$
S720
COMBINE $X' = X + \alpha Y$
S750
INVERSE WT TRANSFORM $D_{WM} = T_{WT}^{-1}(X')$
D_{WM}

Fig. 8

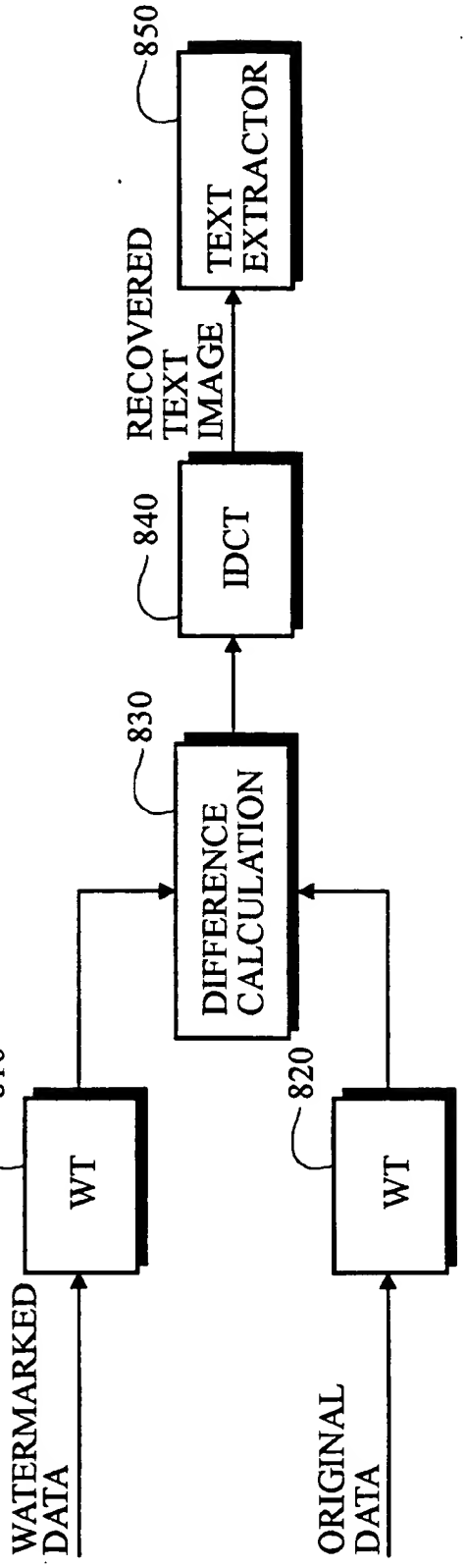

WATERMARKED DATA
ORIGINAL DATA
WT
WT
810
820
DIFFERENCE CALCULATION
830
IDCT
840
RECOVERED TEXT IMAGE
TEXT EXTRACTOR
850

Fig. 9

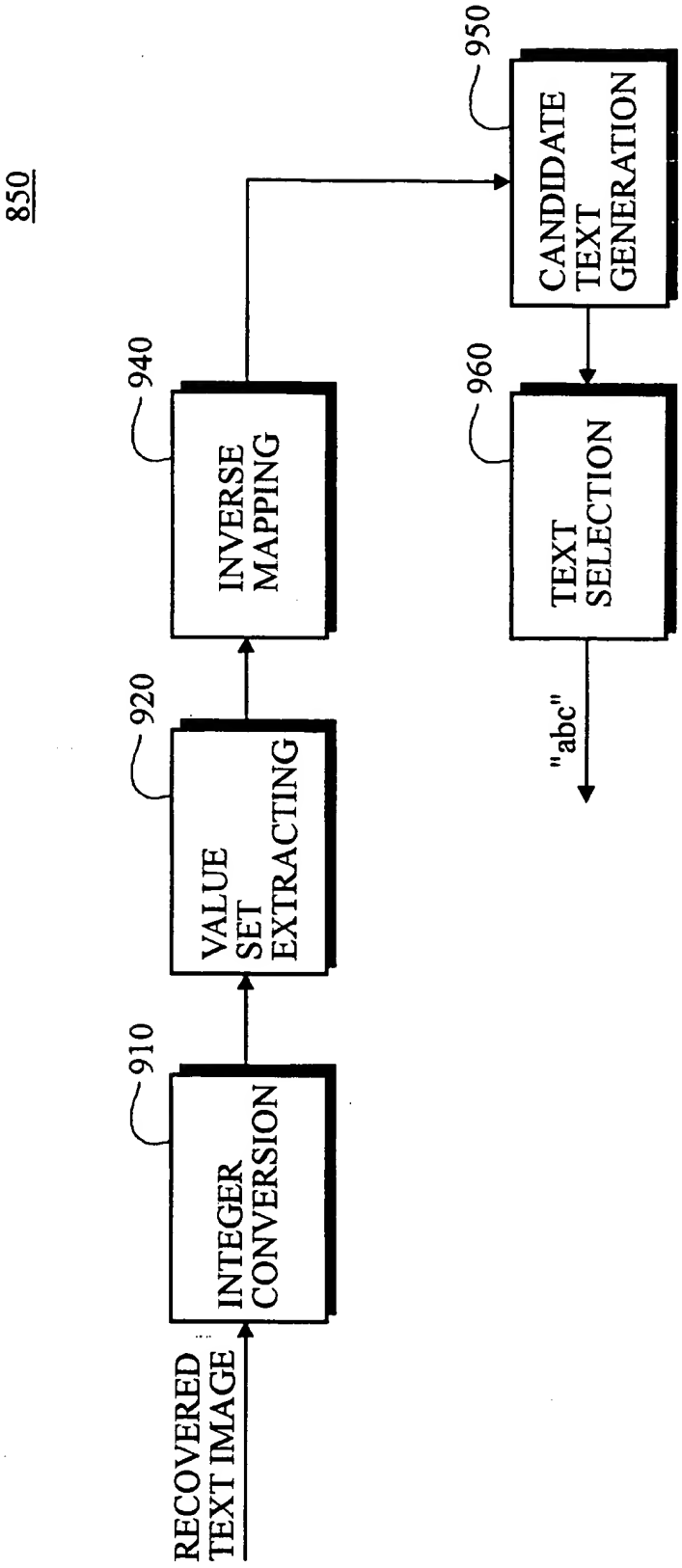

850
RECOVERED TEXT IMAGE
910
INTEGER CONVERSION
920
VALUE SET EXTRACTING
940
INVERSE MAPPING
950
CANDIDATE TEXT GENERATION
960
TEXT SELECTION
"abc"

Fig. 10

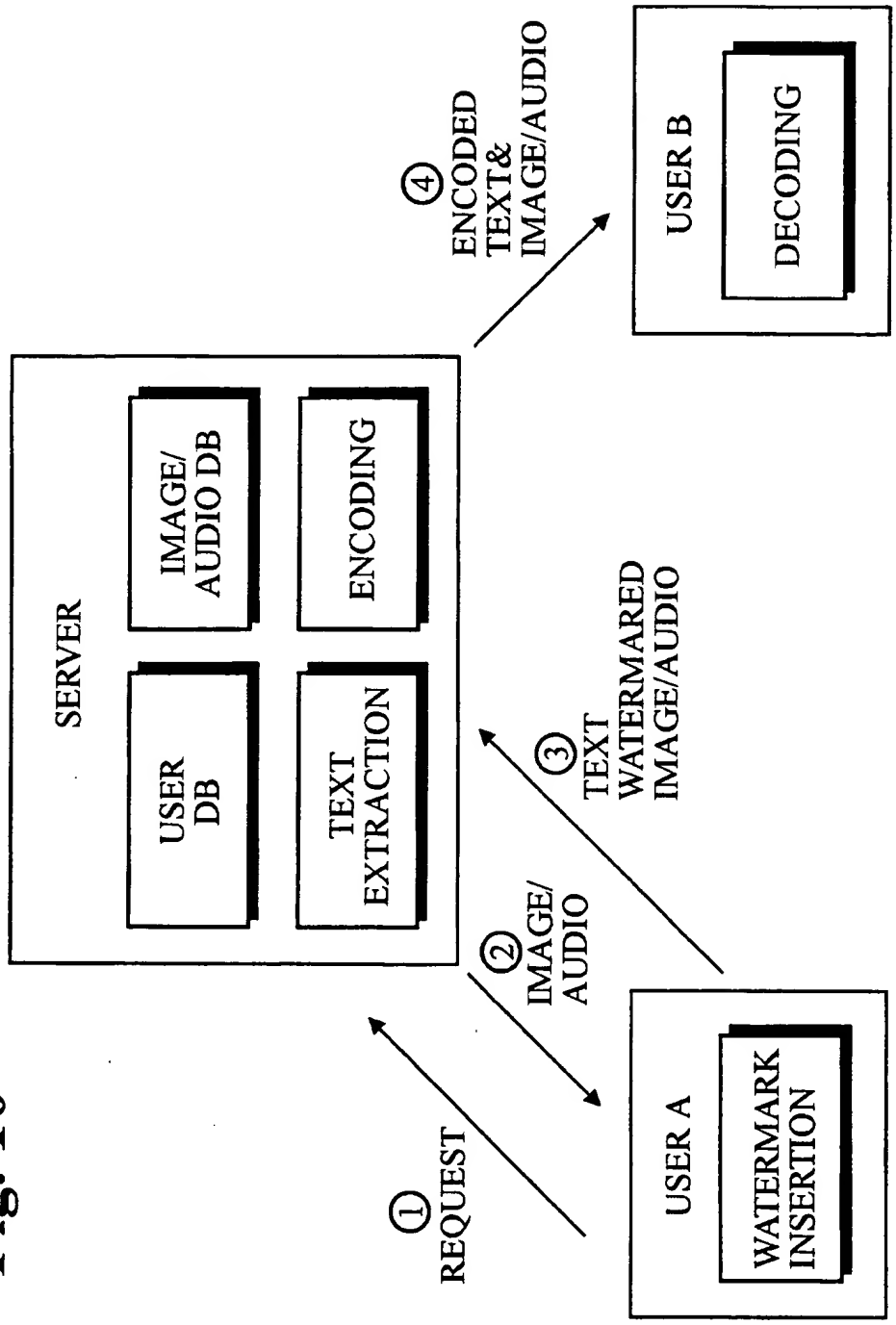
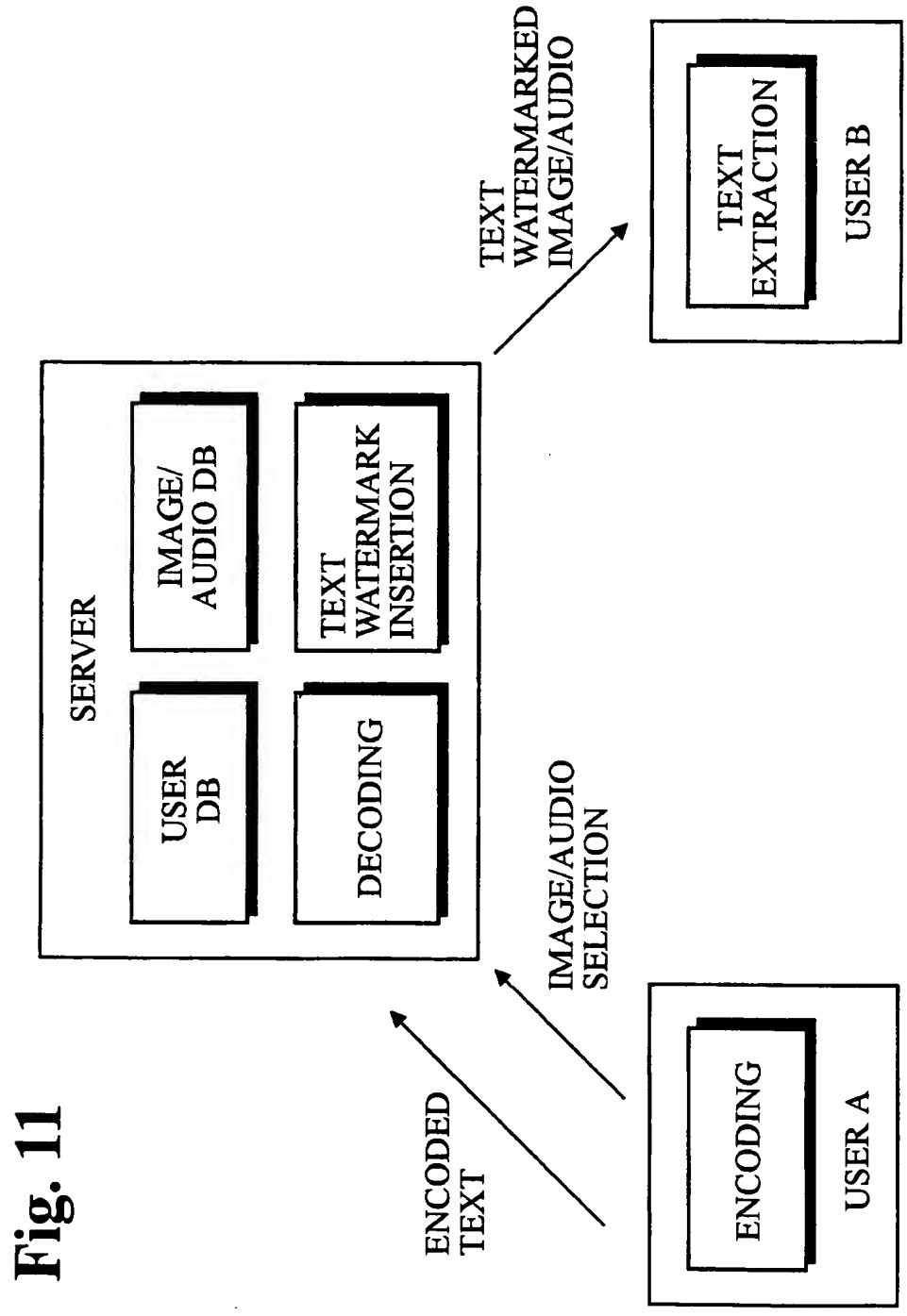

SERVER
USER DB
IMAGE/ AUDIO DB
TEXT EXTRACTION
ENCODING
USER A
WATERMARK INSERTION
USER B
DECODING
① REQUEST
② IMAGE/ AUDIO
③ TEXT WATERMARED IMAGE/AUDIO
④ ENCODED TEXT& IMAGE/AUDIO

Fig. 11


SERVER
USER DB
IMAGE/ AUDIO DB
DECODING
TEXT WATERMARK INSERTION
ENCODED TEXT
IMAGE/AUDIO SELECTION
TEXT WATERMARKED IMAGE/AUDIO
ENCODING
USER A
TEXT EXTRACTION
USER B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 00/01114

CLASSIFICATION OF SUBJECT MATTER

IPC[7]: H04L 9/00, G06F 12/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: G06F 12/14, G06T 1/00, 7/00, H04L 9/00, H04N 7/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/63443 A1 (DATAMARK TECHNOLOGIES PTE LTD) 9 December 1999 (09.12.99) fig. 7, claims 1,2,11,19,37,38,51,62-64	1,2,11,13,14, 16,18-22
A		3-10, 12, 15, 17,23,24
A	EP 0901102 A2 (HITACHI LTD) 10 March 1999 (10.03.99) claims 1,5-8,14,22	1,16,19-24

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
„A" document defining the general state of the art which is not considered to be of particular relevance
„E" earlier application or patent but published on or after the international filing date
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„O" document referring to an oral disclosure, use, exhibition or other means
„P" document published prior to the international filing date but later than the priority date claimed

„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 April 2001 (18.04.2001)	4 May 2001 (04.05.2001)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer FUSSY Telephone No. 1/53424/328

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 00/01114

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP A2 901102	10-03-1999	JP A2 11146363	28-05-1999
EP A3 901102	06-05-1999		
WO A1 9963443	09-12-1999	AU A1 76833/98	20-12-1999